Effects of temperature and season:

About these figures:

Figures show changes in species assemblages in response to water temperature or season. The original data sets were divided into subsets for warm, cold, and neutral periods (or upwelling, oceanic and Davidson current seasons). The NMFS shelf assemblages did reorganize themselves slightly for the three temperatures, but the CDF&G recreational species assemblages changed little for either the three seasons or the three temperatures.

Data Sources:

See associated sections for information on CDF&G recreational hook and line data, and NMFS demersal trawls on the continental shelf.

Methods:

To attempt to quantify the effects of water temperature (recreational and shelf data) and season (recreational data) on the fish and invertebrate assemblages, the original data sets were divided into three subsets sets for warm, cold, and neutral periods and three subsets for the upwelling, oceanic, and Davidson current seasons. Warm and cold periods were provided by David Ainley (see table) and determined by analyzing sea surface temperature anomalies at the Gulf of the Farallones seasonally since 1975. All season/year combinations considered colder than normal were subset together, as were all season/year combinations considered warmer than normal. Likewise, all data collected from March 16- Aug 15, Aug 16 –Nov 15, and Nov 16- Mar 15 were subset together to represent the upwelling, oceanic, and Davidson current seasons, respectively. Seasons were determined through discussions with experts (pers comm. Dan Howard). The 1- Pearson correlation coefficient with average means clustering procedure (described in the extended methods page) was conducted separately on each subset of the data. Tree diagrams (dendrograms) showing species relationships for each subset follow, and provide initial results on how species assemblages change in response to environmental conditions.

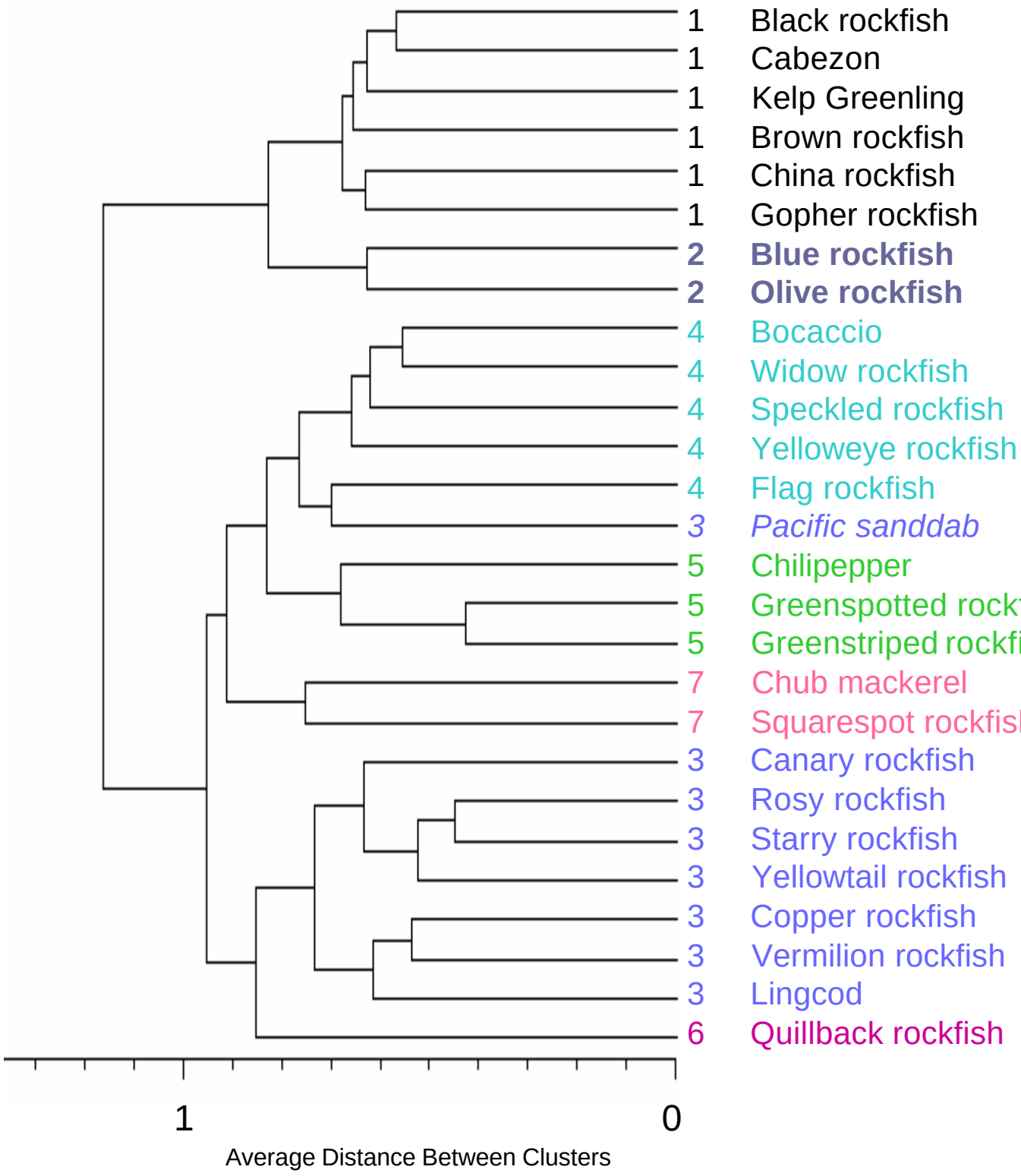
Results:

Results are presented as a series of dendrograms. Common names of the species are provided preceded by a group number. Group numbers show species assemblage results from analyzing all data as presented in the body of this report. Some of the main assemblage groups have been color coded to make visualization of the results easier.

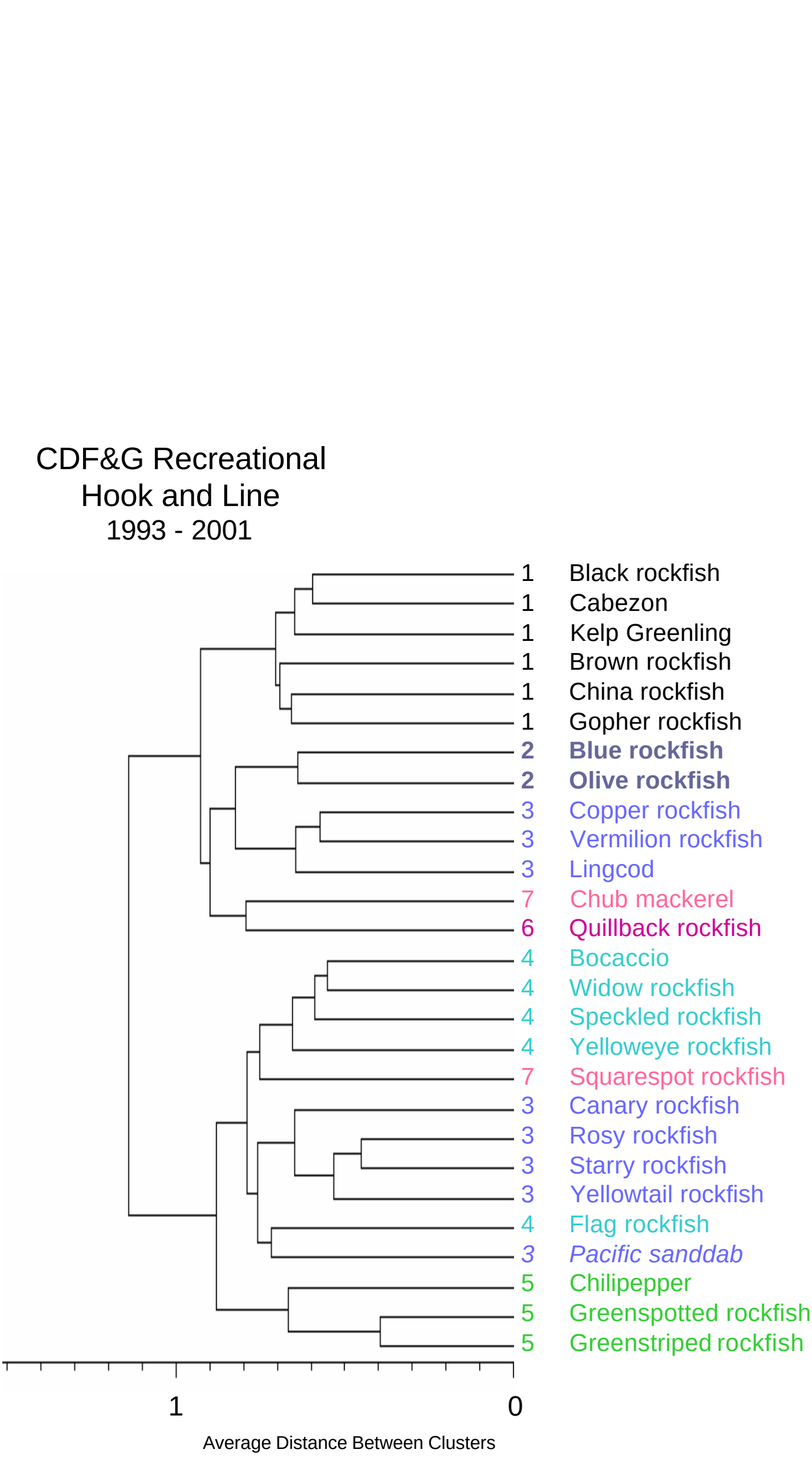
Table. Warm, Cold and Neutral Periods Used in this Analysis

Year	Davidson Current Season	Upwelling Season	Oceanic Season
1975	Cold	Cold	Cold
1976	Cold	Cold	Warm
1977	Warm	Cold	Neutral
1978	Warm	Warm	Cold
1979	Cold	Neutral	Neutral
1980	Warm	Neutral	Cold
1981	Warm	Cold	Cold
1982	Neutral	Neutral	Neutral
1983	Warm	Warm	Warm
1984	Warm	Neutral	Neutral
1985	Cold	Warm	Cold
1986	Neutral	Neutral	Neutral
1987	Warm	Warm	Warm
1988	Neutral	Neutral	Cold
1989	Cold	Neutral	Neutral
1990	Cold	Cold	Neutral
1991	Cold	Cold	Neutral
1992	Warm	Warm	Warm
1993	Warm	Warm	Warm
1994	Warm	Neutral	Cold
1995	Neutral	Warm	Neutral
1996	Warm	Neutral	Cold
1997	Neutral	Neutral	Warm
1998	Warm	Warm	Cold
1999	Cold	Cold	Cold
2000	Cold	Cold	Cold
2001	Cold	Cold	

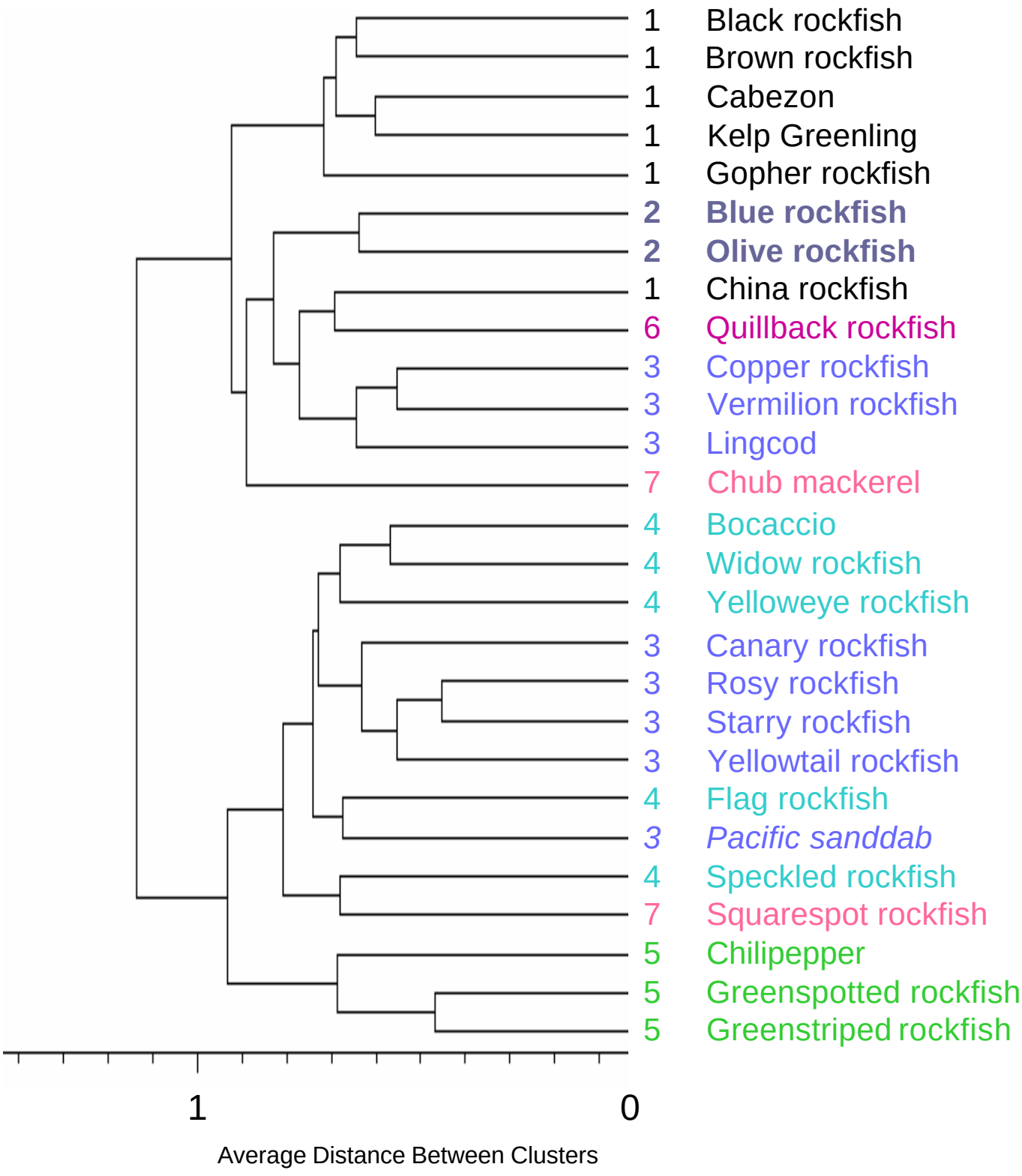
CDF&G Recreational
Hook and Line
All Data



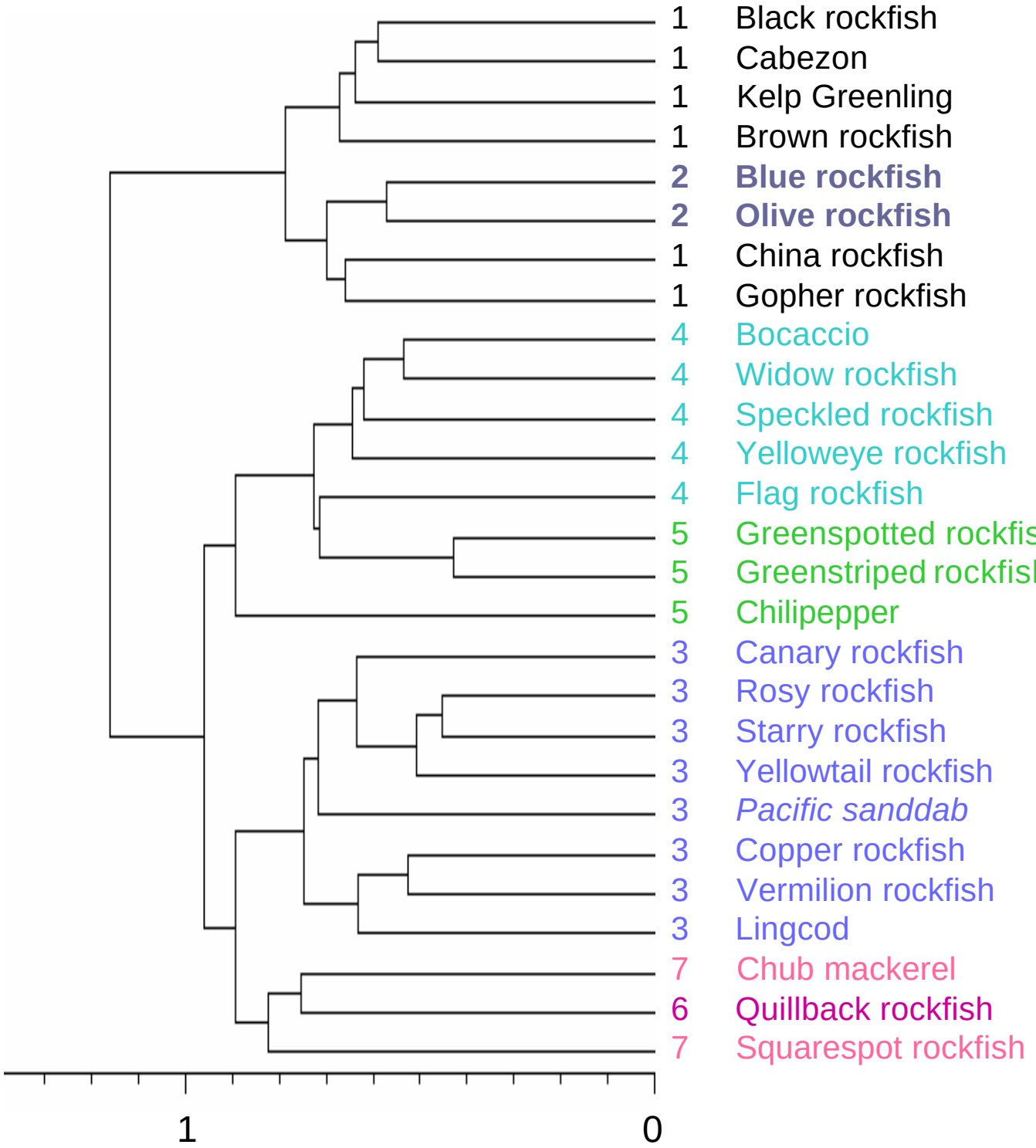
CDF&G Recreational
Hook and Line
1993 - 2001



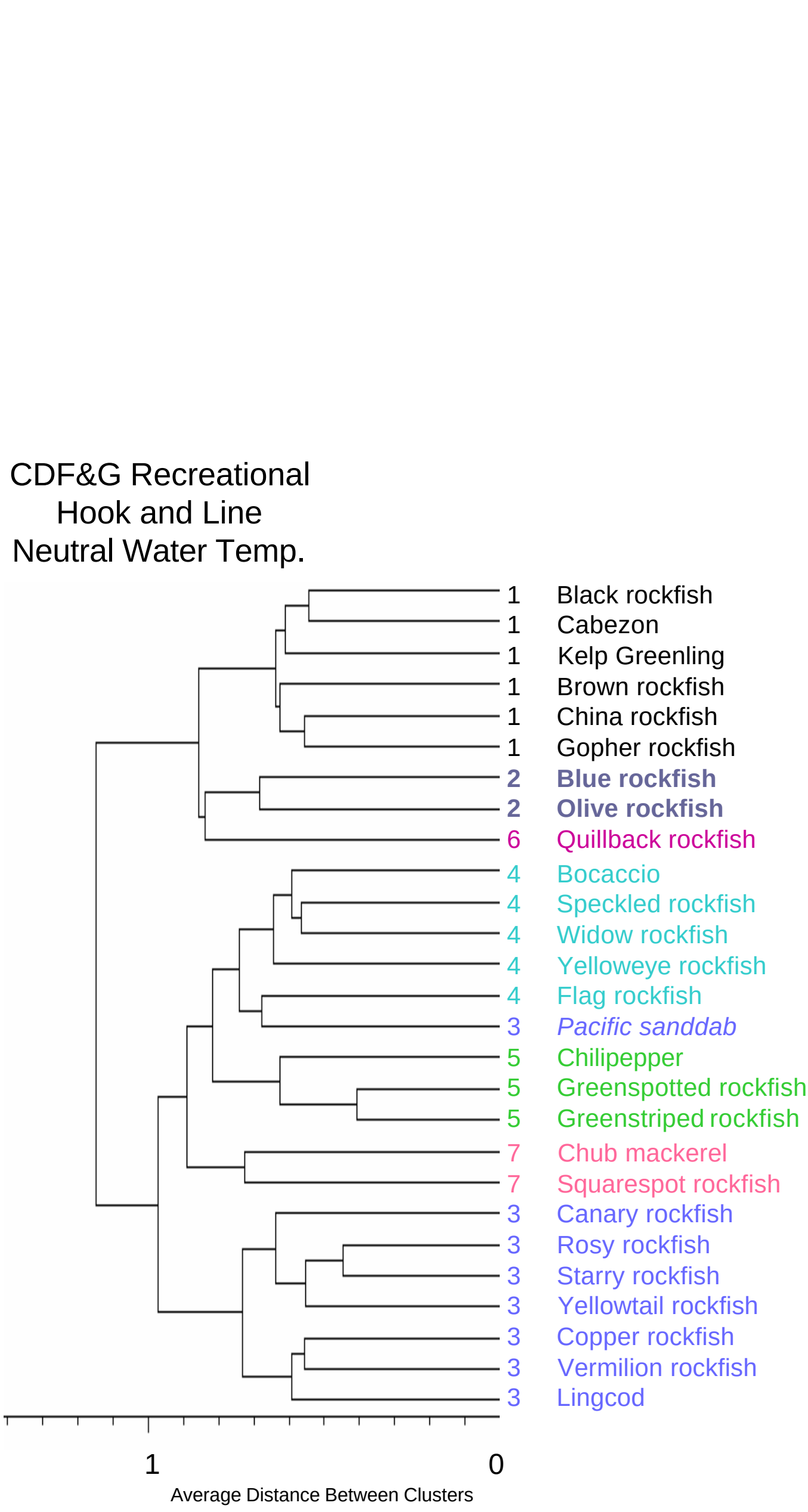
CDF&G Recreational
Hook and Line
Cold Water Temp.



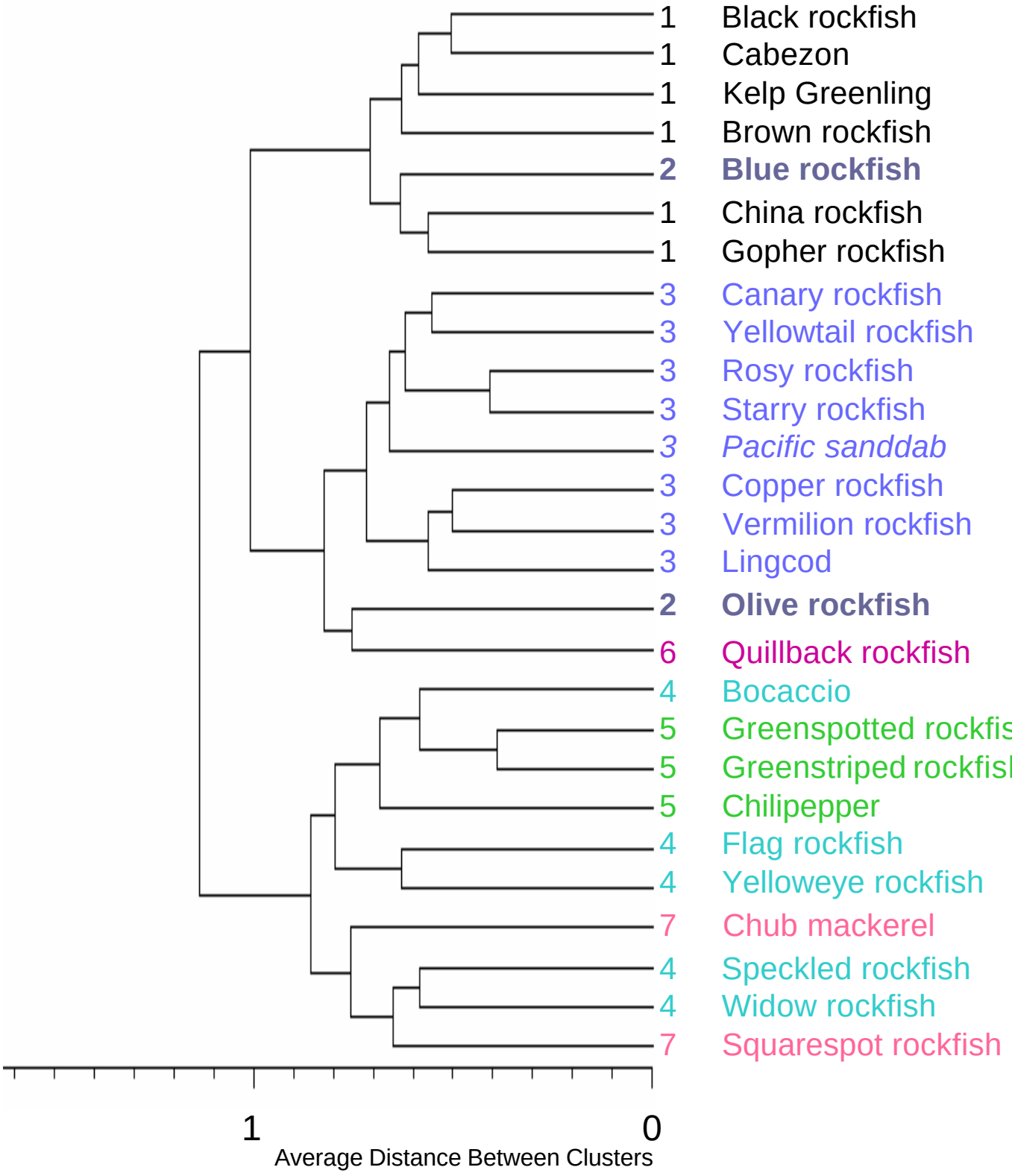
CDF&G Recreational
Hook and Line
Warm Water Temp.



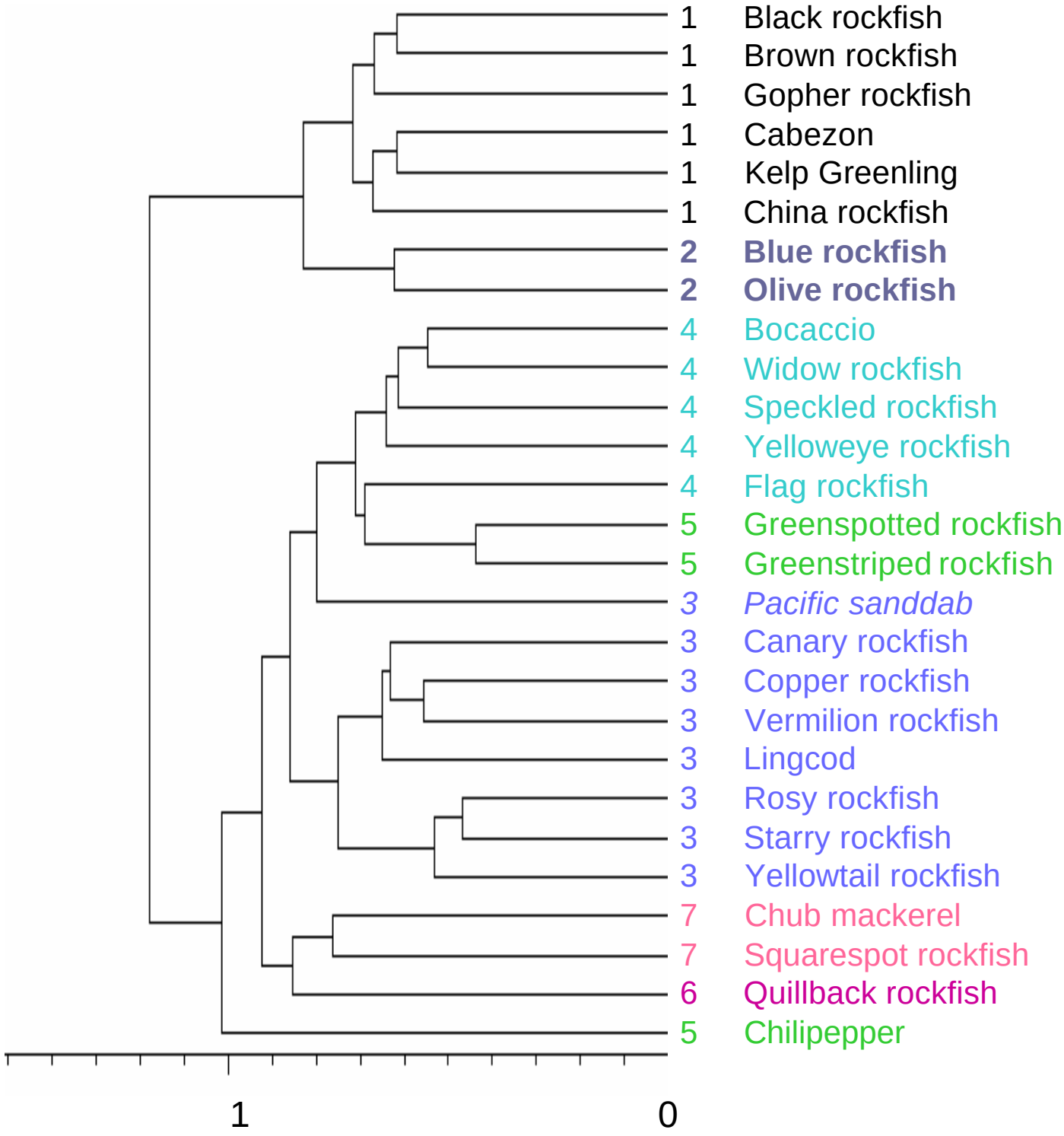
CDF&G Recreational
Hook and Line
Neutral Water Temp.



CDF&G Recreational
Hook and Line
Upwelling Season

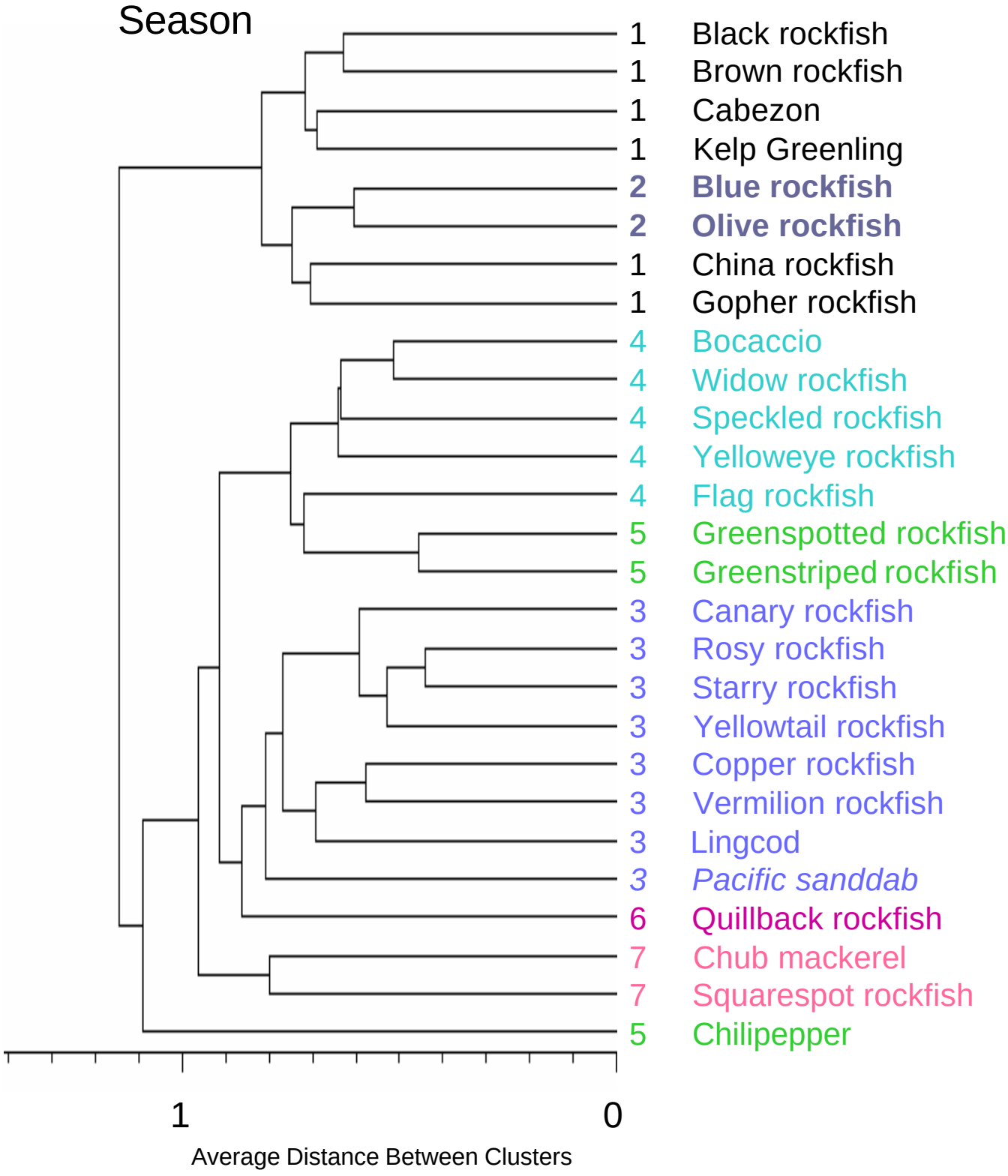


CDF&G Recreational
Hook and Line
Oceanic Season

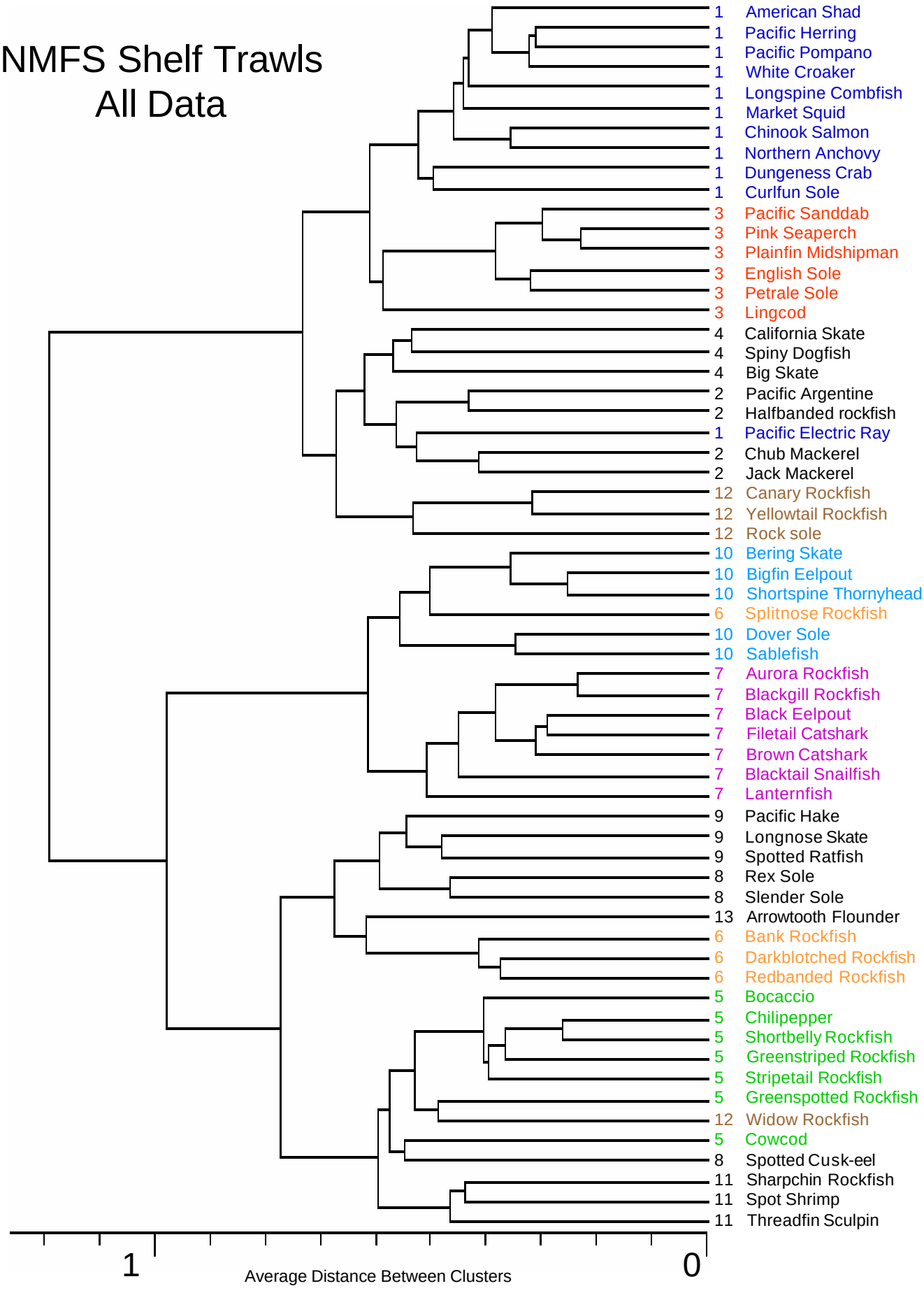


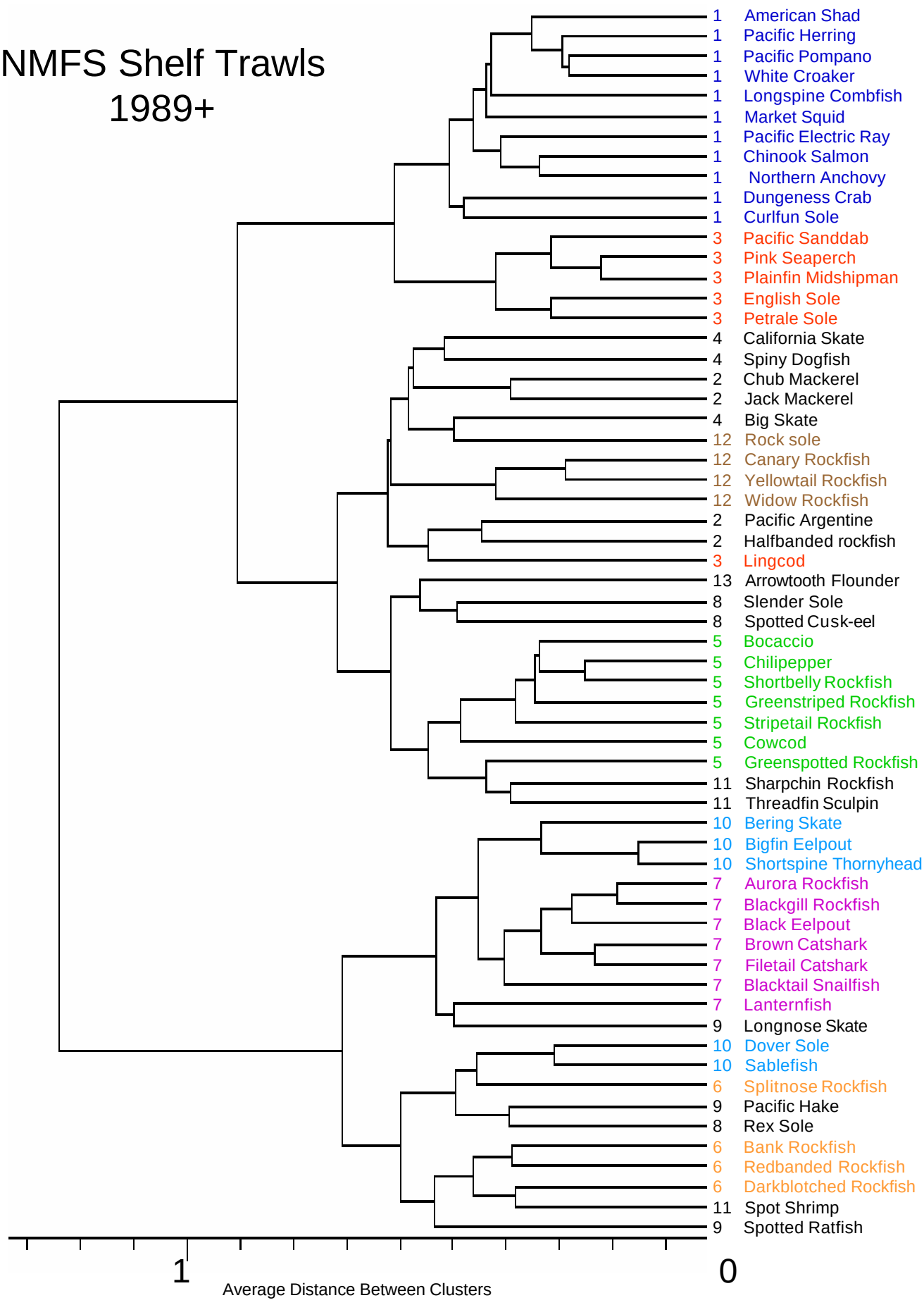
Average Distance Between Clusters

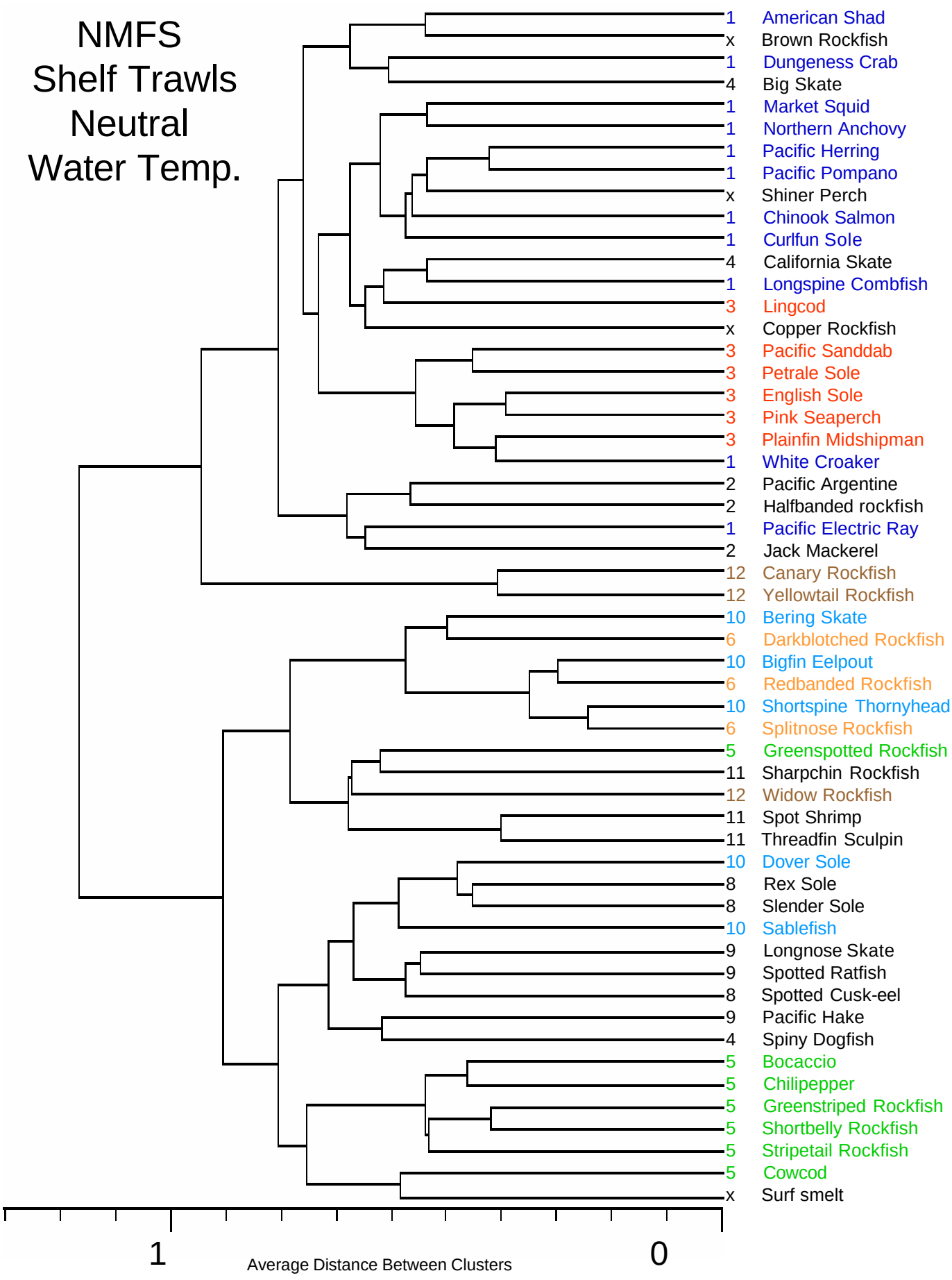
CDF&G Recreational
Hook and Line
Davidson Current
Season

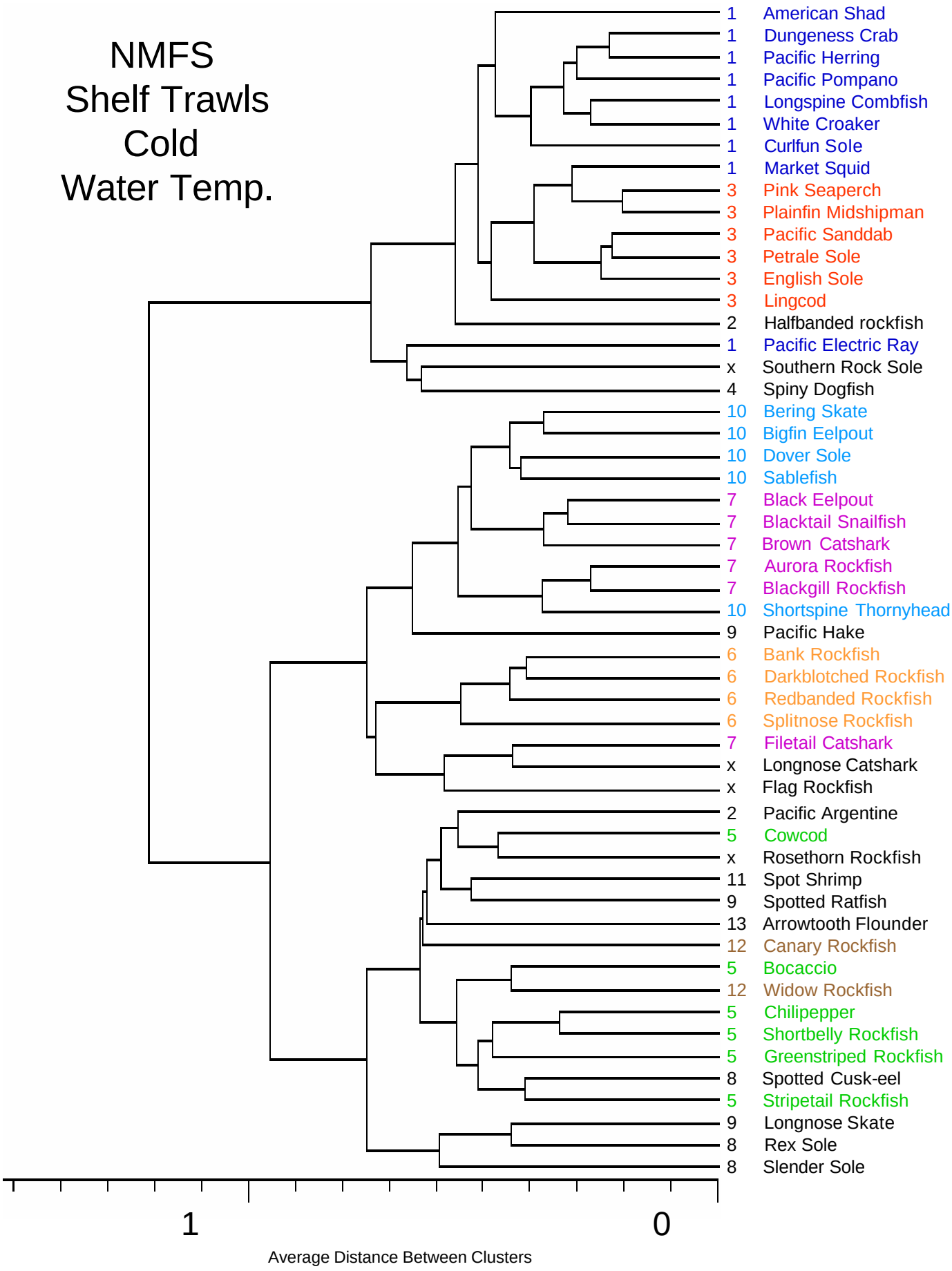


NMFS Shelf Trawls
All Data




NMFS Shelf Trawls
1989+
1 American Shad
1 Pacific Herring
1 Pacific Pompano
1 White Croaker
1 Longspine Combfish
1 Market Squid
1 Pacific Electric Ray
1 Chinook Salmon
1 Northern Anchovy
1 Dungeness Crab
1 Curlfun Sole
3 Pacific Sanddab
3 Pink Seaperch
3 Plainfin Midshipman
3 English Sole
3 Petrale Sole
4 California Skate
4 Spiny Dogfish
2 Chub Mackerel
2 Jack Mackerel
4 Big Skate
12 Rock sole
12 Canary Rockfish
12 Yellowtail Rockfish
12 Widow Rockfish
2 Pacific Argentine
2 Halfbanded rockfish
3 Lingcod
13 Arrowtooth Flounder
8 Slender Sole
8 Spotted Cusk-eel
5 Bocaccio
5 Chilipepper
5 Shortbelly Rockfish
5 Greenstriped Rockfish
5 Stripetail Rockfish
5 Cowcod
5 Greenspotted Rockfish
11 Sharpchin Rockfish
11 Threadfin Sculpin
10 Bering Skate
10 Bigfin Eelpout
10 Shortspine Thornyhead
7 Aurora Rockfish
7 Blackgill Rockfish
7 Black Eelpout
7 Brown Catshark
7 Filetail Catshark
7 Blacktail Snailfish
7 Lanternfish
9 Longnose Skate
10 Dover Sole
10 Sablefish
6 Splitnose Rockfish
9 Pacific Hake
8 Rex Sole
6 Bank Rockfish
6 Redbanded Rockfish
6 Darkblotched Rockfish
11 Spot Shrimp
9 Spotted Ratfish
1
0
Average Distance Between Clusters


NMFS
Shelf Trawls
Neutral
Water Temp.
1 American Shad
x Brown Rockfish
1 Dungeness Crab
4 Big Skate
1 Market Squid
1 Northern Anchovy
1 Pacific Herring
1 Pacific Pompano
x Shiner Perch
1 Chinook Salmon
1 Curlfun Sole
4 California Skate
1 Longspine Combfish
3 Lingcod
x Copper Rockfish
3 Pacific Sanddab
3 Petrale Sole
3 English Sole
3 Pink Seaperch
3 Plainfin Midshipman
1 White Croaker
2 Pacific Argentine
2 Halfbanded rockfish
1 Pacific Electric Ray
2 Jack Mackerel
12 Canary Rockfish
12 Yellowtail Rockfish
10 Bering Skate
6 Darkblotched Rockfish
10 Bigfin Eelpout
6 Redbanded Rockfish
10 Shortspine Thornyhead
6 Splitnose Rockfish
5 Greenspotted Rockfish
11 Sharpchin Rockfish
12 Widow Rockfish
11 Spot Shrimp
11 Threadfin Sculpin
10 Dover Sole
8 Rex Sole
8 Slender Sole
10 Sablefish
9 Longnose Skate
9 Spotted Ratfish
8 Spotted Cusk-eel
9 Pacific Hake
4 Spiny Dogfish
5 Bocaccio
5 Chilipepper
5 Greenstriped Rockfish
5 Shortbelly Rockfish
5 Stripetail Rockfish
5 Cowcod
x Surf smelt
1
0
Average Distance Between Clusters


NMFS
Shelf Trawls
Cold
Water Temp.
1 American Shad
1 Dungeness Crab
1 Pacific Herring
1 Pacific Pompano
1 Longspine Combfish
1 White Croaker
1 Curlfun Sole
1 Market Squid
3 Pink Seaperch
3 Plainfin Midshipman
3 Pacific Sanddab
3 Petrale Sole
3 English Sole
3 Lingcod
2 Halfbanded rockfish
1 Pacific Electric Ray
x Southern Rock Sole
4 Spiny Dogfish
10 Bering Skate
10 Bigfin Eelpout
10 Dover Sole
10 Sablefish
7 Black Eelpout
7 Blacktail Snailfish
7 Brown Catshark
7 Aurora Rockfish
7 Blackgill Rockfish
10 Shortspine Thornyhead
9 Pacific Hake
6 Bank Rockfish
6 Darkblotched Rockfish
6 Redbanded Rockfish
6 Splitnose Rockfish
7 Filetail Catshark
x Longnose Catshark
x Flag Rockfish
2 Pacific Argentine
5 Cowcod
x Rosethorn Rockfish
11 Spot Shrimp
9 Spotted Ratfish
13 Arrowtooth Flounder
12 Canary Rockfish
5 Bocaccio
12 Widow Rockfish
5 Chilipepper
5 Shortbelly Rockfish
5 Greenstriped Rockfish
8 Spotted Cusk-eel
5 Stripetail Rockfish
9 Longnose Skate
8 Rex Sole
8 Slender Sole
1
0
Average Distance Between Clusters

NMFS
Shelf Trawls
Warm
Water Temp.